Stated Meeting, December 4th, 1863.

Present, eighteen members.

President, Dr. WOOD, in the Chair.

Professor McClune, recently elected a member, was introduced to the President, and took his seat.

Letters were received from the Massachusetts Historical Society, acknowledging publications, and from M. Boucher de Perthes, of Abbeville, in France, announcing a donation to the Society.

Donations for the Library were received from Profs. Silliman and Dana, the Essex Institute, Prof. Geo. Ticknor, and the London Reader.

Mr. Briggs made a communication on the application of mathematics to the screw, pointing out certain striking coincidences between the results as computed and as obtained by experiment.

Mr. Briggs wished to communicate to the Society some curious results which had been obtained in an investigation he had made of the strength and the application of forces to the screw-bolt as ordinarily in use by mechanics. He had found first, that the proportions established *by practice* as to the number of threads upon any given diameter of bolt, were those which could be derived from a straight line formula. Thus, Mr. Whitworth's result in collating the practice of English engineers in this respect, could be (with the exception of the half inch bolt, which was too coarse), expressed by the formula $\frac{1}{ad+c}$, where,

d = diameter of belt.
a = a coefficient.
c = a constant.

On proceeding further in the investigation of the subject, he found that every part of the bolt, the diameter of the root of the threads, the heads, the proportions of the nut, &c., was capable of being expressed in a general formula, instead of taking each particular size in the calculations he was desirous of instituting. The general formula of the screw is laid down in most works on applied mechanics, and has the following cumbrous shape.

Let P = the force expended on the arm of the wrench.

a = the length of arm of wrench.

$\dot{a}$ = the angle of inclination of thread or the developed inclined plane of the screw.

β = one half the angle of the thread itself.

φ = the coefficient of friction on the thread surface.

φ' = the " " " nut "

D = diameter of nut outside.

d = " " bolt.

d_2 = " " root of thread.

Q = load on screw parallel to axis, or in other words, the strain on the bolt, thus:

$$Pa = Q\left\{\left[\frac{\tan \dot{a} \pm \varphi \sqrt{1 + \mathrm{Cos}^2 \dot{a}.\tan^2 \beta}}{1 \mp \varphi \tan \dot{a} \sqrt{1 + \mathrm{Cos}^2 \dot{a}.\tan^2 \beta}}\right]\frac{d_2}{2} + \varphi \frac{1}{3}\left[\frac{D^3 - d^3}{D^2 - d^2}\right]\right\}$$

the first member of the coefficient of Q being derived from the inclined plane and the friction of the thread, and the second part from the friction of the nut on its seat.

This cumbrous equation, by having inserted in it definite values for φ and φ' and for β, and the values given by the general formula functions of ad+c before alluded to, underwent the most astonishing reduction to the form

$$Pa = Q\,(Ad + C).$$

where A = a coefficient and C a constant.

Of course, A and C have values differing with different values of φ, φ' and β and also changed by the $\mp$ $\pm$ terms for screwing and unscrewing. But as, in practice, the value of angle

β is fixed at 30°

φ is fixed at about 0.1

φ' " " 0.15

and the value of a in the first formula is established at 0.096

" " c at 0.026 $\therefore$

$$N = \frac{1}{0.096\ d + 0.026}$$

and the value of $D = 1.734\ d + 0.1445$

it results that the formula for summing up becomes

$$\frac{Pa}{Q} = 0.164\ d + 0.008$$

and for unscrewing

$\frac{Pa}{Q} = 0.133\ d$ — a constant so small that it can be neglected.

The investigation went further into the whole consideration of

forces on a bolt, comparison of load per square inch with friction, torsion, combined torsion and tension, strength of nuts, &c. &c. The above gives the result in the more striking and important particulars.

Dr. Wood having requested Judge Sharswood to take the chair, gave a sketch of the water-works of Madrid. Mr. Fraley discussed the subject of an increased supply of water for the city of Philadelphia, advocating the construction of additional reservoirs at various points on the Schuylkill Heights, to be filled from the river by steam-engines. Mr. Trego followed with remarks on the same subject, and Dr. Hays with others, upon the degree of purity of the river water.

The Treasurer's annual report was read and referred to the Finance Committee.

The Publication Committee presented their annual report, as follows: "Since the last report, Part Three (3) of Volume XII has been printed and distributed. The number of subscribers has not materially altered during the past year. The amount received from subscription to the Transactions has been in excess of last year; nevertheless the arrears due are on the increase. The amount paid on publications for the past year is fourteen hundred and thirty dollars and fifty-three cents ($1430 53), of which nine hundred and eighty-six dollars and ninety-two cents ($986 92),* was on account of the Transactions for the last and previous numbers. The receipts amount to one hundred and fifty-two dollars and ninety-two cents ($152 92)."

The report was accepted, and the Society was adjourned.

* Viz., $354 02, cost of Part III, Vol. XII. $632 90, see report Oct. 25th, 1862.